Nests of *Anthocopa enceliae* (Cockerell) and *A. elongata* (Michener)

(Hymenoptera: Megachilidae)

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Nests of *Anthocopa* (an osmiine megachilid) are relatively unknown although Parker (1975) described those of three species. Nests of two species were associated with trap stems, and the nests of one species were located on the undersurface of stones. In additional trap-stem studies conducted in 1974, nests were found of another species in the subgenus *Eremosmia,* and nests of a species in the subgenus *Atoposmia* were found in cracks between stones. Nests, nesting sites, and nest associates of these two species are described, and additional information is presented concerning the previously described nests of *Anthocopa.*

Anthocopa (Eremosmia) enceliae (Cockerell)
(Figs. A, B)

Nesting Site. Seven nests were recovered from prebored elderberry trap stems (Parker and Bohart, 1966). Five were placed in end holes with a bore diameter of 6mm, and two were made in side holes with diameters of 2 and 4mm, respectively. The five nests in end holes contained 45 cells (from five to fourteen cells/nest) and the two in side holes contained three cells (one to two cells/nest). All the nests were from a single site in White Water Canyon, Riverside Co., California, in trap stems I had placed along the side of the canyon among scattered plants of *Encelia* about 50m above the stream bed.

Nest Construction. The prebored burrows were not modified by the bees except that loose pith was removed. They made most of their cells by partitioning across the burrow at intervals ranging between 6 and 10 mm (Fig. A), but in two nests, partitions were placed longitudinally and medially in the boring, thus resulting in the presence of a cell on either side of the partition. The longitudinal partitions were found at the beginning or the end of a cell series. Partitions were made of a sand-masticated leaf pulp mixture spread into a thin (0.5mm) disc. Often the partitions were made obliquely across the burrow, and there was a rimmed and distinct entrance hole through the partition (some osmiine construct the "ceiling" partition prior to cell provisioning and leave a small entrance hole at one side of this partition). The outersurface of the partition was smooth, and the inner was rough. Because the partitions were set at different angles across the burrow, the measurement of the cells varied considerably. The range in cell length was 6-11mm, and the range in width was 2-6mm. The entrance to some burrows was blocked with a compact plug (5-6mm thick) of sand-masticated leaf pulp mixture set into the burrow 5-6mm below the outer surface. The entrance plugs were

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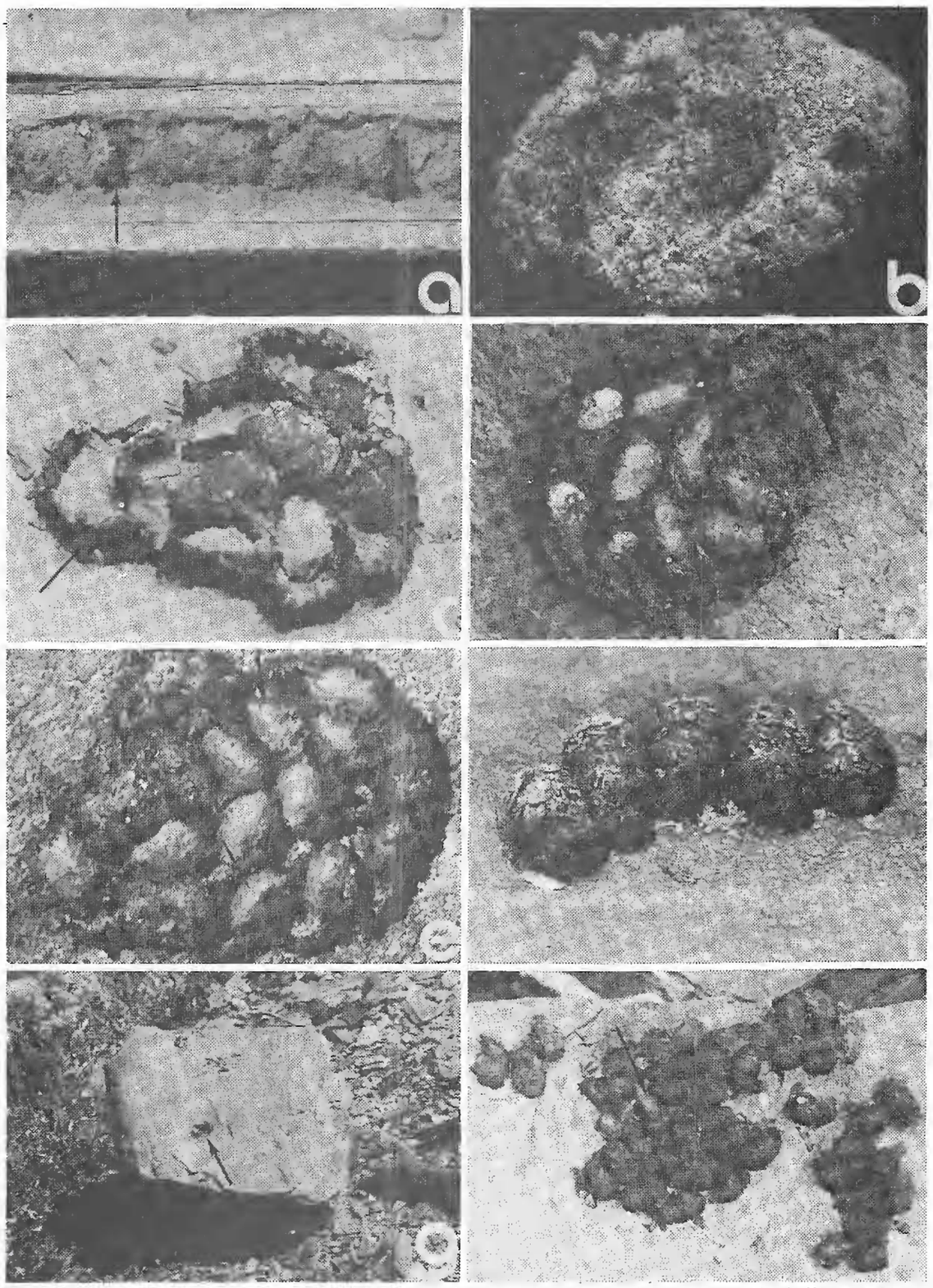

Fig. A. Portion of nest of *A. enceliae* in prebored elderberry trap stem. Dark lines across burrow are cell partitions (arrow). Fig. B. Cocoon of *A. enceliae* removed from cell. Note fecal material and pollen incorporated into cocoon. Fig. C. Seven-celled nest of *A. elongata* containing pollen balls. Arrow indicates wall of new cell. Fig. D. Twelve-celled nest of *A. elongata*. Note fecal pellets against walls of middle cell. Opaque cocoons contain live larvae (arrow). Fig. E. Fifteen-celled nest of *A. elongata* parasitized by *Stelis*. Cocoons of *Stelis* do not fill the cell and are nippled at one end (arrows). Fig. F. Cells of *A. abjecta* attached to underside of rock. Note how dried leaf material is held together by cocoon silk. Fig. G. Four-celled nest of *A. abjecta* on overturned rock (arrow), Willard Pk., Utah. Fig. H. Old nest of *A. abjecta* near margin of overturned stone. Note empty cocoons of *Stelis* (arrow).

H-shaped in a vertical section. The cells made in the side holes were plugged with similar material but were flush with the outer surface of the stem.

Provisions. The cells were "packed" nearly full with pollen from a composite, probably *Encelia.* The pollen mass took the shape of the cells, and it fell apart readily when probed. Because of the crumbly nature of the provisions, egg placement was difficult to ascertain, but it was at the top of the pollen mass. Most cells had a small space between the entrance hole in the partition and the pollen.

Feces. The fecal pellets were amber colored, barely less than 1mm long, slightly bowed, with one end blunt and the other pointed. They were scattered around the sides of the cell and combined into the cocoon strands.

Cocoons. The bees made their distinctive cocoons by closely lining the cell walls with abundant strands of compact whitish silk. Unconsumed pollen and fecal pellets were incorporated into this thick matlike outer layer. The outer layer was asymmetrical and conformed to the cell walls (Fig. B). Also its thickness was unusual: the outer layer of one cocoon was 5X heavier (26mg) than the inner sheath (5.4mg). This outer layer often filled most of the available cell space. A layer of thin varnishlike material was applied on the inside of the outer layer of silk. Longitudinal strands of fecal material were smeared on the inside of the varnished layer. The larvae formed the inner cocoon by thinly coating the fecal material with light brown silk. The strands were more evident in the upper half though the inside of this layer was smooth and shiny. The inner cocoon was barrel-shaped and averaged 6x4mm; the top had a flat or slightly raised area (nipple) distinct from the surrounding surface.

Overwintering. Diapause is passed as bowed, yellowish white prepupal larvae. Prepupae incubated at 72°F produced males in 57-59 days and females in 58-62 days.

Sex Ratio. Only two males and three females emerged.

Nest Associates and Mortality. The common chalcid parasite, *Leucospis affinis* Say, was reared from six cells. Dead eggs or young larvae were recorded in 27% of the cells, and 40% of the cocoons contained dead larvae after incubation.

Discussion. Nests of *A. enceliae* differ from those of the other known species in the subgenus *Eremosmia, A. hypostomalis* Michener, in that *A. enceliae* partitions the burrows and cells and *hypostomalis* makes individual cells composed entirely of masticated leaf pulp and sand. Cocoons of the two species differ in that those of *enceliae* are the shape of the cell and the nipple does not protrude. Cocoons of *hypostomalis* are barrel-shaped with a prominent nipple. Similarities exist in the nests of these two species since both are constructed of a mixture of sand and masticated plant parts. Similarities also exist between cells of *A. enceliae* and cells of species of

Osmia. For example, the thick whitish outer layer of the cocoon of *A. enceliae* is similar to that spun by *Osmia texana* Cresson; also the habit of filling the cell with pollen is found in *Osmia*, notably *O. californica* Cresson.

Nests of *A. enceliae* were obtained at the locality where I had placed trap stems two previous years. However, in 1974, I placed some stems along the side of the canyon and in the stream bed. Nests of this *Anthocopa* were recovered only from stems on sides of the canyon; nests of *A. hypostomalis* were recovered from both locations.

Anthocopa (Eremosmia) hypostomalis Michener

Nests and nest associates of *A. hypostomalis* were described previously (Parker, 1975). An additional 61 nests were obtained from trap nests, all but one made in the end hole. The nests contained 260 cells (an average of 4.4 cells/nest with a range of 1-13). In 1974, at the White Water Canyon 45% of the end holes in the trap stems contained this species. Other locations where nests of *A. hypostomalis* were recovered were: CALIFORNIA: 15 mi. N Johannesburg, 24 mi. E Keeler, Yucca Valley, Morongo Valley, 11 mi. NE Bishop, 3 mi. N Bishop, 7 mi. S Palm Springs. UTAH: Hurricane. ARIZONA: 3 mi. S Oatman.

The same species of nest associates reported earlier were found in the new nests. A new association was demonstrated by three cells containing adults of the meloid *Nemognatha*.

Anthocopa (Atoposmia) elongata Michener
(Figs. C, D, E)

Nesting Site. All nests of *A. elongata* were associated with rock outcroppings and were constructed in cracks between stones. Nests were found at several places in the mountains surrounding Logan, Utah. At Willard Peak, Box Elder Co., the nests were located between broken layers of shale along the trail leading to the summit (9700 ft). In Logan Canyon, nests were located in rocky ledges at Blind Hollow, near the Franklin Basin turnoff, and along Beaver Creek.

Nest Construction. All nests were found in cracks 2-3mm wide; both vertical and horizontal cracks contained nests. Many old nests were found relatively undisturbed except for the exit holes of the bees and parasites. The 20 nests found averaged 11.4 cells/nest with a range of 3-23 cells/nest. No nests during the early stage of construction were found, and data on formation can only be surmised. Since most nests were oval, the initial cell is probably central, and additional cells are attached to it in a circular pattern (Fig. C). The bees began their cells by making a thin U-shaped corral-like wall from masticated plant parts and fine sand. They made additional cells by attaching another wall to the first or to other cells, thereby utilizing an existing surface as one side of the cell (Fig. C, arrow). Cell walls at

the outer rim of the nests were as thick as 2mm. Cells were 5-6mm long and 3-4mm wide, and there was no discernable pattern in cell orientation as some cells faced outward and some faced toward the center of the nest (Fig. D).

Provisions. The provisions were shaped into an oval ball (Fig. C) that contained loose pollen grains on the outside. Enough nectar was added to bring the pollen mass to a gum-like consistancy. Stereoscan micrographs of pollen made from several nests were identified by P. Lincoln (UC-Santa Cruz) as *Penstemon.* Moldenke and Neff (1974) reported that *A. elongata* was an oligolege of *Penstemon.* The host egg was deposited at the top and to one side of the mass.

Feces. Many pellets were found at the top of the cell where they had been deposited before cocoon formation (Fig. D). Other pellets were scattered along the sides of the cell. The pellets were yellowish-white, 0.5-0.6mm, 0.1-0.2mm wide, slightly bowed, pointed at the ends, and with an impressed longitudinal line. Other pellets were flattened against the walls during cocoon spinning.

Cocoon. The cell walls were closely lined with a thin amber-colored, translucent layer of silk. The top of the cocoon was composed of coarse, loose silk strands that filled the space under the cell cap. Below this silk, the top of the cocoon was loosely spun and (in most specimens) a small opening was left. The inner surface of the cocoon was shiny with the strands forming this layer distinct. The larvae inside were easy to see through the cocoon (Fig. D).

Overwintering. The overwintering stage was a prepupal larva. The incubated larvae required 57-58 days at 72° F to become adults. They were C-shaped, white, and very active when probed.

Sex Ratio. Sixteen females and eight males emerged.

Parasites. The most abundant parasite associated with *A. elongata* was an undescribed species of *Stelis (Chelynia)* (Fig. E). This small black parasite is one of the smallest (4mm) species that I have seen in the subgenus *Chelynia*. Fourteen percent of the cells in both old and active nests had been parasitized by *Stelis.* Two cells in one nest were parasitized by the common bombyliid, *Anthrax irroratus* Say. Another common bee parasite reared from this host was *Tetrastichus megachilidis* Burks, which was found in nine cells in active nests. Many bee larvae in old nests also had been parasitized by *Tetrastichus*.

Discussion. A. elongata cells differ from those of the other known species in the subgenus *Atoposmia* in that *elongata* builds cell partitions and does not line all surfaces with cell-building material; *A. abjecta* makes separate cells and lines the entire cell with nest-building material (Fig. F). The cocoons of both species are similar, especially the loosely spun and coarse silk at the top. Cells of *A. (Hexosmia) copelandica* (Cockerell) are similar to those of *A. elongata*

in that the cell walls are closely lined and the cocoon takes the shape of the cell; the fecal pellets are of similar size and shape, and the material used to build cell partitions is mostly masticated plant parts.

Anthocopa (Atoposmia) abjecta (Cresson) (Figs. F, G, H)

Nests of *A. abjecta* were described by Parker (1975) and additional nests of *A. abjecta* were located at Willard Pk., Utah, attached to the undersurface of stones (Fig. G). The nine nests found averaged 9.2 cells/nest with a range of 3-38. No live parasites were recovered, but some old nests contained cocoons of *Stelis* (Fig. H).

Anthocopa (Hexosmia) copelandica (Cockerell)

Nests of *A. copelandica* were described earlier (Parker, 1975). Additional trap-stem studies during the years 1973 and 1974 produced nests from the following locations: ARIZONA: Kingman. UTAH: Logan Canyon, Cache Co. (3 sites); 9 mi W Mendon, Cache Co.; Willard Peak, Box Elder Co. CALIFORNIA: 5 mi. S Kramer Jct., 15 mi. N Johannesburg, 14 mi. N Little Lake. The 109 nests recovered contained 591 cells with a range of 1-18 cells/nest. New nest associates of *A. copelandica* are: the megachilids, *Stelis (Chelynia) subemarginatam* (Cresson) from eleven cells and *Stelis (Microstelis) lateralis* Cresson from ten cells; the chrysidid parasite *Chrysura kyrae* Krombein from two cells; the bombyliid *Anthrax irroratus* from seven cells; and the common clerid predator *Trichodes ornatus* Say from ten cells.

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